Remarks/Arguments

Applicants have received and carefully reviewed the Office Action mailed December 22, 2004, setting a three month shortened statutory period for response ending March 22, 2005. Claims 1-33 remain pending, with claims 32-33 being newly presented. Reexamination and reconsideration are respectfully requested.

Rejection under 35 U.S.C. § 103(a)

Claims 1-31 are rejected under 35 U.S.C. § 103(b) as being unpatentable over Pedrazzini in view of Plunkett and Lannes et al. and Dunfield. The Examiner states that Pedrazzini discloses a motor generating bemf, a controller for controlling the speed of the motor, circuitry allowing the controller to sample bemf of the motor where the controller uses sampled bemf as feedback for controlling the speed (citing Pedrazzini, column 2, lines 20-28, column 4, lines 39-44 and column 5, lines 19-35). The Examiner acknowledges that Pedrazzini does not disclose an average of sampled bemf, a valve, a damper vane, or a nominal value and measured speed for calibration. However, the Examiner states that Plunkett discloses an average value of sampled bemf (citing Plunkett, column 2, lines 55-65). The Examiner also states that Lannes et al. disclosed a damper vane and valve (citing Lannes et al., page 2, paragraphs 17 and 18). The Examiner further states that Dunfield discloses a nominal value and a measured speed for calibration (citing Dunfield, column 10, lines 42-60). The Examiner then concludes that it would have been obvious to one or ordinary skill in the art to combine the control of Pedrazzini with average sampling of Plunkett, damper vane and motor control.

After careful review, Applicants must respectfully disagree with the Examiner's reasoning. Pedrazzini relates to a system that uses a voice coil, while Plunkett uses a rotating

type electric motor. A voice coil does not have an armature that rotates in full revolutions about an axis, but rather typically only rotates along an arc. Also, voice coils typically do not have a multiple magnets or a commutation period, at least in the same way as rotating type electric motors, and thus voice coils operate in a significantly different manner. Therefore, Applicants do not believe it is appropriate to combine Pedrazzini and Plunkett as the Examiner suggests. Notable, the Examiner does not provide any motivation or reasons why it would have been obvious to make the proposed combination.

Although Applicants respectfully disagree with the Examiner's rejection, and to move the case along, claim 1 has been amended to recite:

> 1. (Currently Amended) An actuator comprising:
>
> a ~~an~~ rotating electric motor having a rotating armature, two or more magnets, and one or more coils, wherein ~~that generates~~ a back emf is generated when the one or more coils pass through the lines of flux of the two or more magnets, the back emf varying during each commutation period of the motor;
>
> a control system for controlling the speed of the ~~electric~~ motor, the control system including:
>
> a controller;
>
> circuitry for allowing the controller to obtain a measure that is related to an average ~~sample the~~ back emf ~~of the motor~~ over at least one commutation period of the motor, wherein the controller uses the ~~sampled~~ measure that is related to the average back emf as feedback representative of motor speed for use in controlling the speed of the motor.

As can be seen, claim 1 now recites that the back emf varies during each commutation period of the motor. Claim 1 also recites obtaining a measure that is related to an average back emf over at least one commutation period of the motor. None of Pedrazzini, Plunkett, Lannes et al. or Dunfield disclose or suggest such a configuration.

As noted above, the Examiner acknowledges that Pedrazzini does not disclose an average of sampled bemf. However, the Examiner states that Plunkett discloses an average value of sampled bemf (citing Plunkett, column 2, lines 55-65). The cited portion of Plunkett states:

> This voltage sample is the motor voltage during the time the motor emf makes the transition from one of the DC bus potentials to the other. The average value of this sample is zero when the motor rotor is correctly aligned with the inverter. This voltage sample produces a signal which is supplied to an error amplifier whose output is connected to a voltage controlled oscillator. The voltage controlled oscillator controls the frequency and phase angle at which the multiphase inverter selectively energizes the windings.

(Plunkett, column 2, line 60 through column 3, line 2) (Emphasis Added). As can be seen, and as better shown in Figure 6 of Plunkett, the emf of the motor is sampled by an integrator during a time period between when the corresponding lower transistors turn off and the corresponding upper transistors turn on, and again during a time period between when the corresponding upper transistors turn off and the corresponding lower transistors turn on. If the phase of, say the phase error signal TP5 labeled "A" at the bottom of Figure 6, were to be shifted to the right or left, the integral of the phase error signal "A" curve would be non-zero. The control of Plunkett appears to adjust the frequency and phase angle of the Voltage Controlled Oscillator (VCO) so that the integral of the phase error signal TP5 is zero.

Clearly, Plunkett does not obtain a measure that is related to an average back emf over at least one commutation period of the motor, as recited in claim 1. As shown in Figure 6, Plunkett only obtains an "integral" of the phase error during a relatively small portion of the commutation period of the motor (i.e. during the time period between when the corresponding lower transistors turn off and the corresponding upper transistors turn on, and again during a time period between when the corresponding upper transistors turn off and the corresponding lower transistors turn on). Also, the "integral" taken during the positive transition (labeled "A" in Figure 6) and the "integral" taken during the negative transition (labeled "-A in Figure 6) do not appear to be combined to "obtain a measure that is related to an average back emf over at least one commutation period of the motor", as recited in claim 1. In view of the foregoing, claim 1 is

believed to be clearly patentable over the cited prior art. For similar and other reasons, dependent claims 2-18 are also believed to be clearly patentable over the cited art.

Specifically with respect to dependent claim 4, which recites:

> 4. (Original) The actuator of claim 3, wherein the motor drive circuit is turned off for a period of time greater than the off-time of the duty cycle.

Nothing in Pedrazzini or Plunkett appears to disclose or suggest turning off the motor drive circuit for a period of time that is greater than the "off-time" of the duty cycle of the motor drive circuit, as recited in claim 4. Instead, it appears that both Pedrazzini and Plunkett perform "sampling" of the bemf during the "off-time" of the duty cycle that is provided by the motor drive circuit during normal drive operations of the motor.

Specifically with respect to dependent claim 9, which recites:

> 9. (Currently Amended) The actuator of claim [[1]] 8, wherein the permanent magnet brush motor generates a back emf having a waveform, and wherein the controller uses the circuitry to sample[[s]] multiple back emf values over a time period corresponding generally to one wavelength of the waveform.

Nothing in Pedrazzini or Plunkett appears to disclose or suggest sampling multiple back emf values over a time period corresponding generally to one wavelength of the waveform of the back emf. In Plunkett, and again referring to Figure 6, the emf appears to be only sampled during a relatively small portion of a wavelength of the waveform of the back emf (i.e. during the time period between when the corresponding lower transistors turn off and the corresponding upper transistors turn on, and again during a time period between when the corresponding upper transistors turn off and the corresponding lower transistors turn on).

Specifically with respect to dependent claim 11, which recites:

> 11. (Currently Amended) The actuator of claim 9, wherein the controller uses the circuitry to sample[[s]] at least 4 back emf values over a time period corresponding to one wavelength of the waveform.

Nothing in Pedrazzini or Plunkett appears to disclose or suggest sampling at least 4 back emf values over a time period corresponding to one wavelength of the waveform. Similar comments can be made with respect to dependent claims 12-13.

For similar reasons to those given above with respect to claim 1, independent claim 19 and independent 26 are believed to be clearly patentable over the cited art. For similar and other reasons, dependent claims 20-25 and 27-30 are also believed to be clearly patentable over the cited prior art.

Turning now to claim 31, which recites:

> 31. (Original) A method for calibrating a speed control system for an electric motor, the method comprising:
> running the motor using a nominal value as a speed command;
> measuring the motor speed generated by the nominal value; and
> using the ratio of the nominal value and the measured speed to calibrate the speed control system with respect to the motor.

The Examiner cites to column 10, lines 42-60 of Dunfield as disclosing a nominal value and a measured speed for calibration. Column 10, lines 42-60 of Dunfield states:

> After the motor attains medium speed, it is accelerated to and maintained at nominal speed. With continuing reference to FIGS. 14 and 15, step 142 corresponds to controlling the speed of a brushless DC motor as described in "Closed Loop Control Of A Brushless DC Motor At Nominal Speed," U.S. Pat. No. 5,245,256, which is incorporated by reference as if fully set forth herein. Here, the speed of the motor is determined using the back emf zero-crossings, measured only on complete rotor revolutions without the use of conventional rotor position location devices is described. The desired speed is monitored by comparing the measured speed with the desired speed, and adjusting motor current accordingly. A block diagram of a highly accurate control system for accelerating a brushless DC motor from medium speed to nominal speed and then maintain a constant nominal speed is provided in FIG. 3 of the referenced patent. FIGS. 7A to 7H of the referenced patent comprise a detailed flow diagram of the operation of the control system of FIG. 3 thereof.

Nothing here appears to disclose the method recited in claim 31, and in particular, a method of calibrating a speed control system. As noted in the present specification:

> Variations in the manufacturing process for electric motors can result in motors whose back emf constant varies by plus or minus 10%, or more, from motor to motor. To overcome this problem, it may be desirable to calibrate the actuator 20 as part of the manufacturing process. This can be accomplished by running the actuator 20 with a nominal value for the speed command. The rotational speed of the armature of the motor is measured with an external device, and a new speed command is calculated that will cause the actuator to run at the desired speed.

(Specification, page 6, line 27 through page 7, line 4). As such, claim 31 is believed to be clearly patentable over the cited prior art. If the Examiner elects to maintain this rejection, Applicants respectfully request that the Examiner specifically point out where in Dunfield or any other art of record such a method is disclosed.

Claims 32-33 are newly presented. Claim 32 recites:

> 32. (New) An actuator comprising:
> an electric motor that generates a back emf with a generally repeating waveform; and
> a controller, the controller adapted to obtain a measure that is related to an average back emf of the motor over a time period corresponding generally to at least one wavelength of the waveform, the controller further adapted to use the measure that is related to the average back emf to control the speed of the motor.

As can be seen, claim 32 recites a controller adapted to obtain a measure that is related to an average back emf of the motor over a time period corresponding generally to at least one wavelength of the waveform of the back emf. Claim 32 also recites that the controller is further adapted to use the measure that is related to the average back emf to control the speed of the motor. For similar reasons to those given above with respect to claims 1 and 9 above, new claim 32 is believed to be clearly patentable over the cited prior art.

New claim 33 recites:

33. (New) A method for controlling the speed of an electric motor, the method comprising:

supplying current to the motor to drive the motor at a first speed, the supply current being driven at a frequency that corresponds to the first speed with current peaks and current valleys;

suspending the supply of current such that at least one current peak and/or current valley is skipped;

while the supply of current is suspended, allowing the current to decay to zero or substantially zero and then obtaining a measure of the back emf generated by the motor; and

using the measure of the back emf as feedback to control the speed of the motor.

As can be seen, claim 33 recites the step of suspending the supply of current such that at least one current peak and/or current valley is skipped. Nothing in Pedrazzini or Plunkett suggests this step. Claim 33 also recites, while the supply of current is suspended, allowing the current to decay to zero or substantially zero and then obtaining a measure of the back emf generated by the motor. Again, Nothing in Pedrazzini or Plunkett suggests this step. For these and other reasons, new claim 33 is also believed to be clearly patentable over the cited prior art.

In view of the foregoing, Applicant believes that all pending claims 1-33 are in condition for allowance. Reexamination and reconsideration are respectfully requested. If the examiner believes it would be beneficial to discuss the application or its examination in any way, please call the undersigned at (612) 359-9348.

Respectfully submitted,

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